Condensed Matter Physics

X-RAY DIFFRACTION AND RAMAN SCATTERING STUDIES OF $Pb_{1-x}Sr_xTiO_3$ FILMS GROWN BY METALORGANIC DECOMPOSITION

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Ferroelectric thin films are of current interest because of their potential in microelectronics applications, including memory devices, sensor technologies, and optoelectronic devices. Thin films of lead titanate $PbTiO_3$ (PT) and its related solid solutions offer key advantages for a wide variety of applications. For example, the ferroelectric to paraelectric phase transition temperature (Curie temperature) in lead strontium titanate $Pb_{1-x}Sr_xTiO_3$ (PST) can be adjusted over an exceedingly large temperature range by adjusting the Pb to Sr ratio. Earlier studies on bulk PST for $0 \le x \le 1$ have shown that the Curie temperature decreases linearly with increasing Sr concentration.[1]

In the present work we have studied $Pb_{1-x}Sr_xTiO_3$ (x = 0 to 1) films of thickness ~ 4 μm prepared on sapphire and platinum substrates by the metalorganic decomposition (MOD) technique. Separate solutions of $PbTiO_3$ and $SrTiO_3$ were mixed to obtain the desired stoichiometric $Pb_{1-x}Sr_xTiO_3$ metalorganic solution. Films were prepared by dispensing the metalorganic solution onto substrates (2 cm × 2 cm × 0.25 mm) and spinning them at 4000 rpm for 15 seconds. Multiple coats (30) were made in order to obtain the desired film thickness. Finally the films were annealed at 950°C for 1 hour. X-ray diffraction results show that the films are polycrystalline with a perovskite tetragonal phase for $x < 0.6$ as seen by the splitting in the (*h00*) and (*00l*) peaks at room temperature and a cubic phase for $x > 0.6$. The Raman spectra of the samples were recorded using a single grating spectrometer equipped with a charge coupled detector device and holographic notch filters and the 514.5 nm wavelength light from an argon laser as the excitation source. Room-temperature Raman spectra show a systematic variation of lattice vibrational modes with composition. The most notable changes in the Raman spectra are the coalescence of A_1(3TO) and E(3TO) modes into one for $x \ge 0.6$, and a considerable softening of A_1 (2TO) mode.

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[1] S. Subrahmanyam and E. Goo, *Acta Mater*. **46**, 817, 1998.

M. J. Smith and S. LaPointe were supported by NSF-REU grant No. EEC-0097736.